STEAM ISA REPORT

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Goal: Design a device that would help someone with a disability to move around more easily.

Our design: A wearable device designed for individuals with cerebral palsy.

This smart glove utilises advanced sensors and AI algorithms to interpret muscle signals, allowing for more precise and responsive control of robotic exoskeletons or other mobility aids. The glove is customizable, adapting to each user's unique needs, creating greater independence and improved mobility.

We initially had the idea to create this device after building hydraulic hands in STEM club, where we explored the movement of the hand, and mechanical ways of holding onto objects.We understood that cerebral palsy causes a person to lose control over their muscles before we started this project, and several of us knew people who had the condition. But after doing a lot of investigation, we discovered that the condition was far more widespread and affected more than simply muscular control.

Consequently, we made the decision to develop MobilityAssistCP, a glove that combines AI with other technologies to give users the most precise and customised experience possible. By making each glove strap unique for each user, we enable AI to learn how to better serve and support the user, whether it be with regard to finger movements that are more natural than others or tightening of the straps in the fingers.

* The MobilityAssist CP is equipped with surface electromyography (sEMG) sensors \* that detect and interpret electrical signals generated by muscle activity. These signals are then processed by AI algorithms, helping the glove to understand the people’s intended movements.
* The glove is also designed to be modular and adaptable. People can choose from a range of attachments, for example, robotic exoskeleton fingers or a supportive wrist brace, depending on their specific mobility challenges. The modular design ensures that the device can be tailored to each individual's needs and progression over time.
* In addition to its assistive features, the glove incorporates a haptic feedback system. This provides users with sensory input, enhancing their awareness of their movements and surroundings. This feedback loop helps users refine their motor control, ultimately promoting better coordination and muscle strength.
* The MobilityAssist CP is also equipped with Bluetooth connectivity, allowing users to sync the device with a mobile app. The app provides real-time performance data, personalised training plans, and monitoring by healthcare professionals. This connectivity involves both users and their healthcare providers in the ongoing improvement of mobility.
* With its technology and user-centric design, the MobilityAssist CP aims to empower individuals with cerebral palsy by enhancing their mobility, independence, and overall quality of life.

\* A sEMG sensor is an electrochemical transducer that detects biopotentials by using electrodes placed on the skin. Since the measured potentials have small amplitudes, <30 mV when measured on the muscle fibre and <1 mV when measured on the skin surface, the potentials are susceptible to electromagnetic interference.

PROJECT EXPLANATION AND DETAILS

This project is designed to help people with cerebral palsy, using a glove device that detects electrical signals.

Cerebral palsy (CP) is a group of disorders that impact a person's mobility, balance, and posture. The most typical motor impairment in children is CP. The word cerebral refers to brain-related matters. Palsy is a term used to describe muscle weakness or dysfunction.

Some impairments that come with CP include stiff muscles (spasticity) associated with damage to the cerebral cortex, uncontrollable movements (dyskinesia), associated with damage to the basal ganglia, and a lack of muscle control. In designing this MobilityAssistCP glove, we would be helping those with CP move and control their muscles better.

DESIGN BASICS

The design of the MobilityAssist CP would prioritise comfort, flexibility, and user-friendly features. Here's a description of the design:

1. The glove would be made of lightweight, breathable, and flexible materials, making it comfortable during prolonged use. The structure would be ergonomic, conforming to the natural shape of the hand and wrist to minimise discomfort and allow for natural movement.

2. The glove would have modular components that users can easily attach and detach based on their specific needs. These components may include robotic fingers, wrist braces, or other supportive elements.

3. Surface electromyography (sEMG) sensors would be strategically embedded throughout the glove to capture muscle signals accurately. These sensors should be unobtrusive and designed to minimise any discomfort.

4. The haptic feedback system would be integrated into key areas of the glove, providing users with tactile sensations. This feedback system may consist of small, vibration modules that offer subtle cues to enhance the user's awareness of their movements.

5. The glove would include Bluetooth connectivity to sync with a dedicated mobile app. This would enable users to access real-time performance data, personalised training plans, and facilitate remote monitoring by healthcare professionals.

6. Adjustable straps and closures would be incorporated to ensure a secure and personalised fit for users of various hand sizes. This feature is crucial for both comfort and effective use.

7. The glove would house a compact power and control unit, containing the AI algorithms and necessary hardware for processing muscle signals. This unit could be positioned on the wrist or integrated seamlessly into the glove design.

8. A simple and intuitive user interface, possibly a touch-sensitive panel or buttons, would allow users to control and customise the device easily.

9. It would be equipped with a rechargeable battery to ensure sufficient power for extended use. The battery would be designed for efficiency and compactness.

10. Because it would be used daily, the glove would be designed to withstand wear and tear. Additionally, it should be easy to clean, considering hygiene requirements.

EXPECTED OUTCOME

The expected outcome of our product would be a device aiding cerebral palsy that would improve someone's daily tasks such as picking up objects and doing any other basic functions that are needed for daily life. It will also try to help the people using the device to use their hands and other parts of the body that have been affected by cerebral palsy. We also strive to make the experience of using the device as adaptable and normal-looking as possible to ensure comfort and aesthetic appeal. We also hope to make it accessible to all patients diagnosed with CP despite their economic or social background. Furthermore, the MobilityAssist CP will have high tech AI algorithms that will provide the users with the highest quality functions. Ensuring that they get the best experience possible with price, comfortability and style . It will also help to strengthen the wearer’s hand over time. As they will be able to do more activities, allowing the muscles to strengthen and develop more.